Exhibit 2

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Margol et al.

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(54) **REMOTE VEHICLE PROGRAMMING SYSTEM AND METHOD**

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G07C 5/00 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 8/61*** (2013.01); ***G07C 5/008*** (2013.01); *G07C 2205/02* (2013.01)

(58) **Field of Classification Search**
CPC G06F 8/61; G07C 5/008; G07C 2205/02; G07C 5/0808

(Continued)

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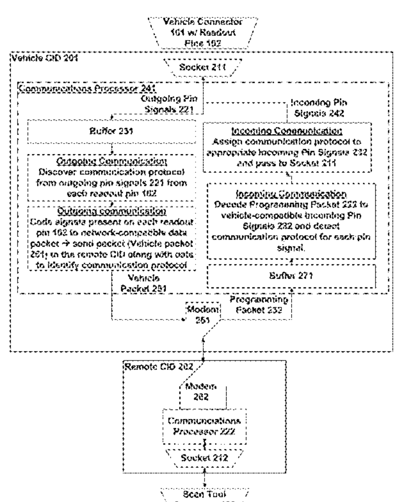
(57) **ABSTRACT**

A system and method for remotely programming a vehicle including a vehicle connector with a plurality of pins in communication with one or more vehicle sub-systems or modules, a vehicle communication device connected to the vehicle connector; a bi-directional communication link between the vehicle communication device and a remote communication device, and a computer system connected to the remote communication device. The vehicle communication device is configured to receive signals from the pins, convert the signals to a network compatible data packet which can then be transmitted to the remote communication device, which re-converts the signals to the pin signals, which can be read by a computing system, such as a vehicle scan tool. Programming instructions can be sent from the scan tool to the vehicle, over the bi-directional communication link between the remote communication device and the vehicle communication device.

10 Claims, 8 Drawing Sheets



(58) **Field of Classification Search**
USPC 701/32.7, 31.4–31.5
See application file for complete search history.

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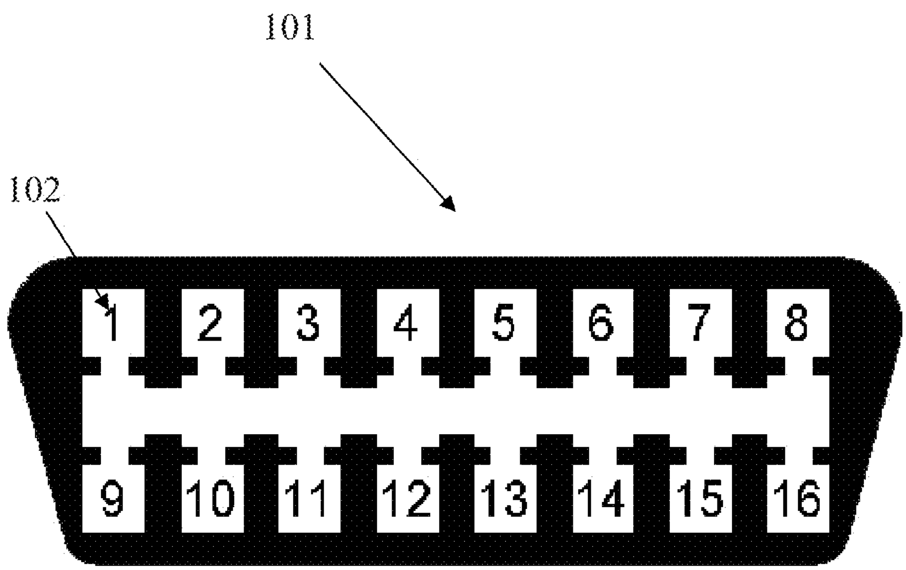

Figure 1

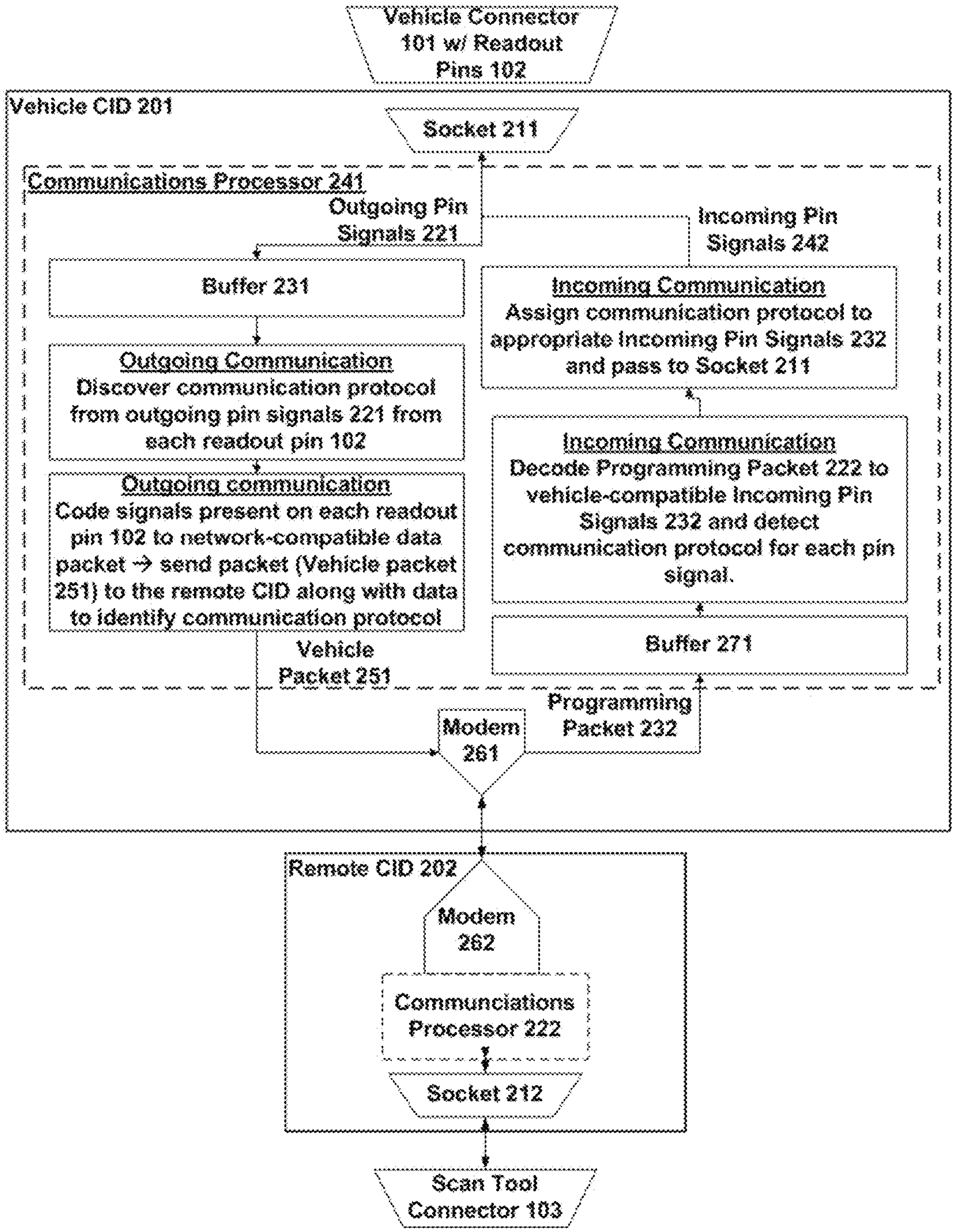
Vehicle Connector 101 w/ Readout Pins 102
Vehicle CID 201
Socket 211
Communications Processor 241
Outgoing Pin Signals 221
Incoming Pin Signals 242
Buffer 231
Incoming Communication
Assign communication protocol to appropriate Incoming Pin Signals 232 and pass to Socket 211
Outgoing Communication
Discover communication protocol from outgoing pin signals 221 from each readout pin 102
Incoming Communication
Decode Programming Packet 222 to vehicle-compatible Incoming Pin Signals 232 and detect communication protocol for each pin signal.
Outgoing communication
Code signals present on each readout pin 102 to network-compatible data packet → send packet (Vehicle packet 251) to the remote CID along with data to identify communication protocol
Buffer 271
Vehicle Packet 251
Programming Packet 232
Modem 261
Remote CID 202
Modem 262
Communciations Processor 222
Socket 212
Scan Tool Connector 103

Figure 2

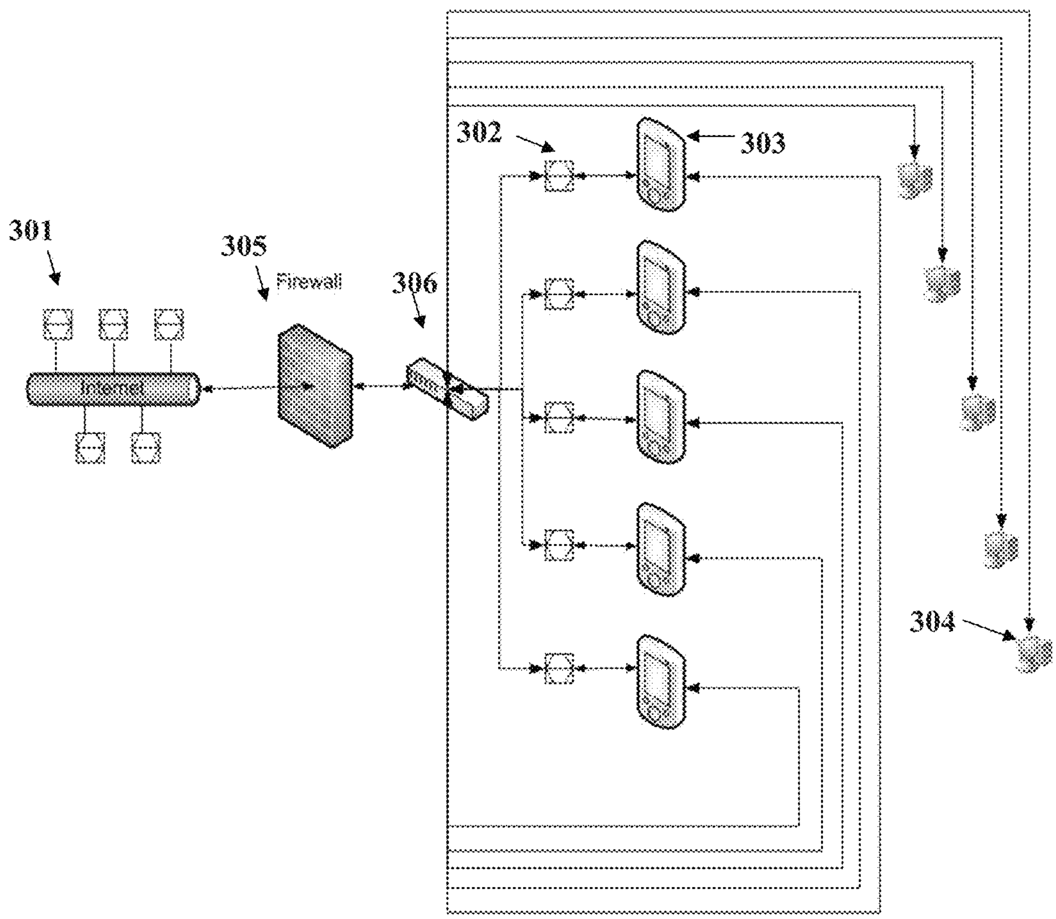

Figure 3

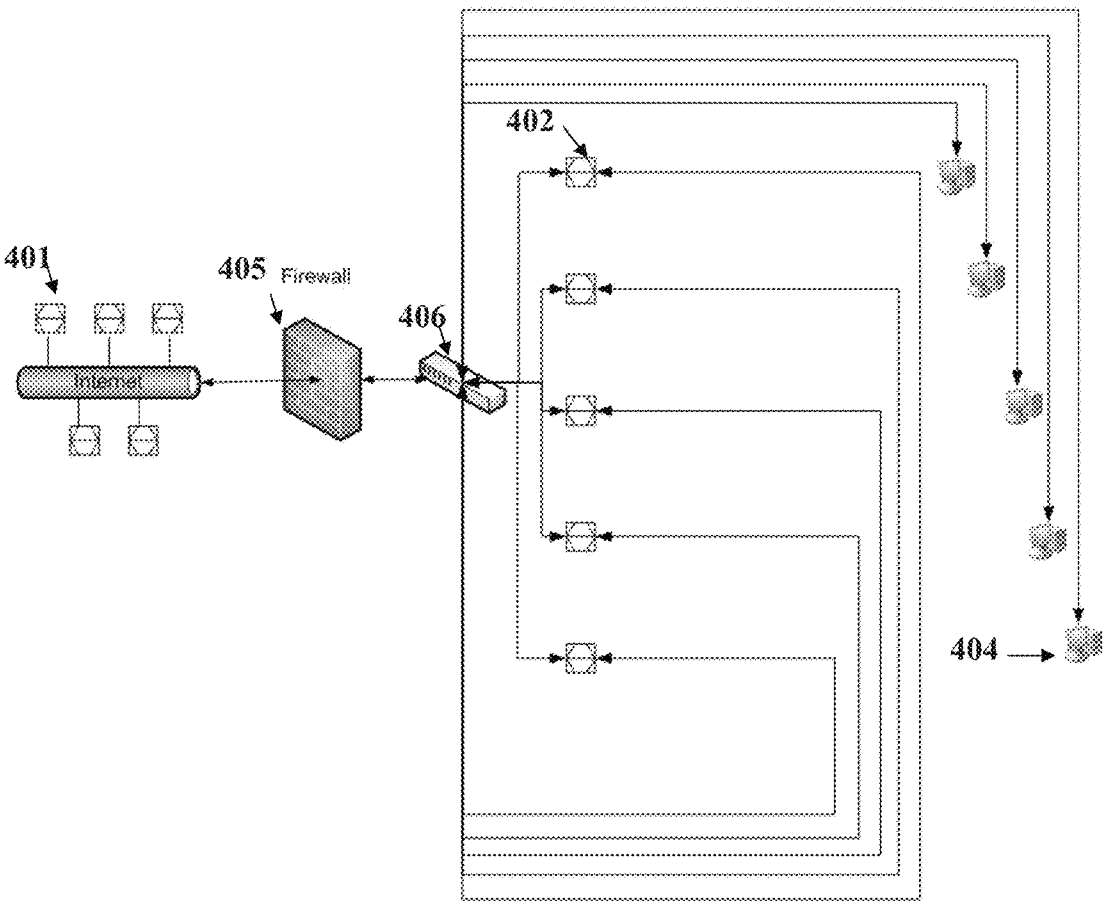

Figure 4

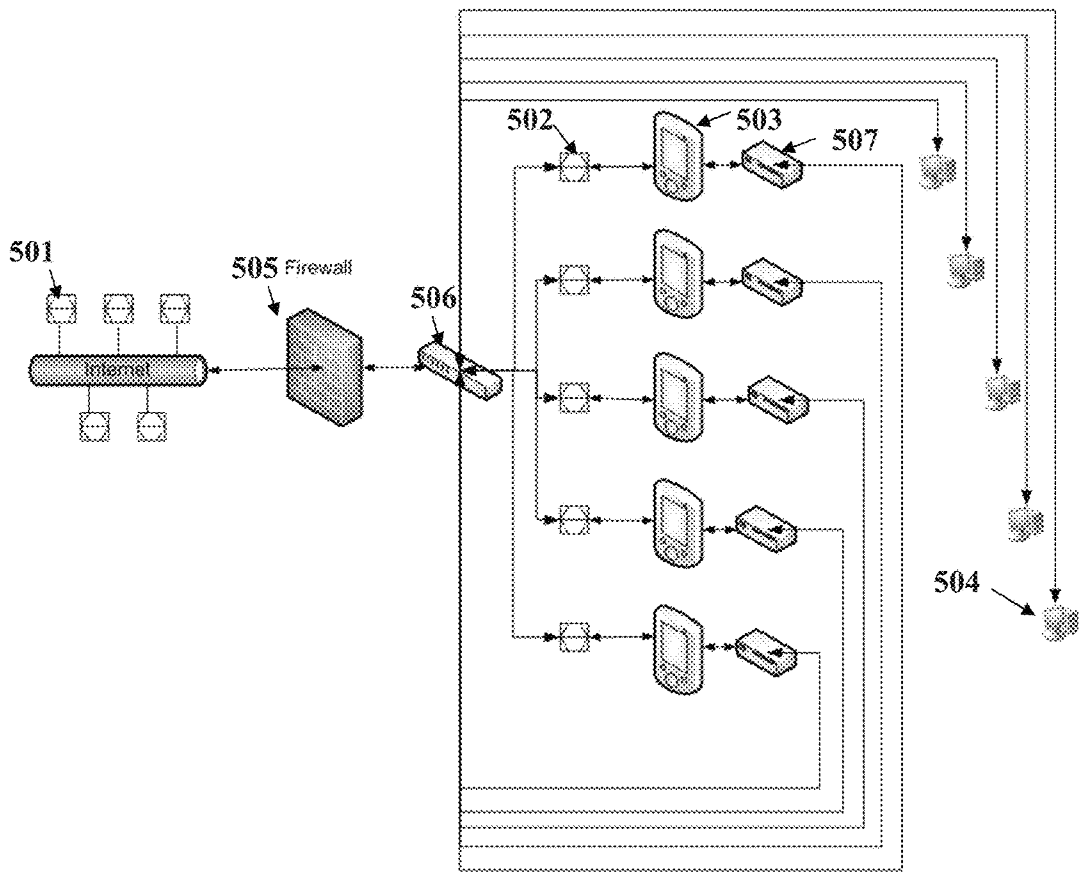

Figure 5

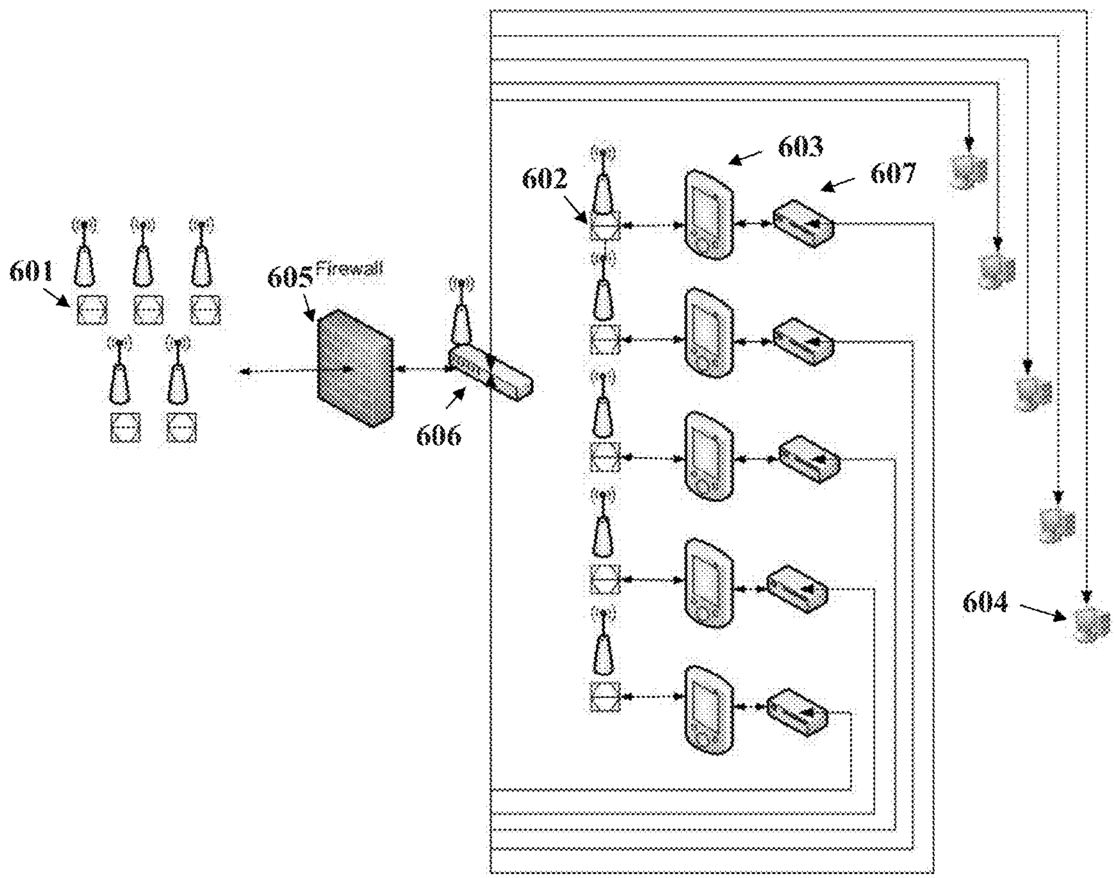

Figure 6

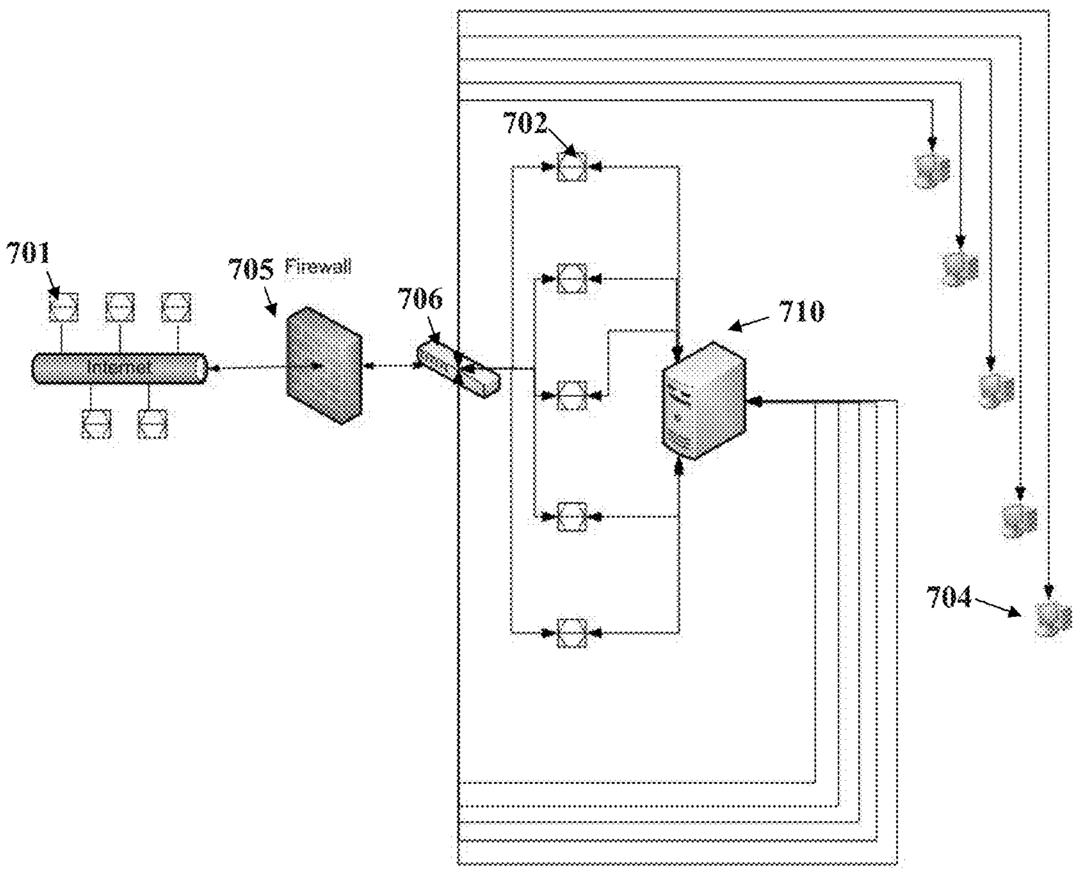

Figure 7

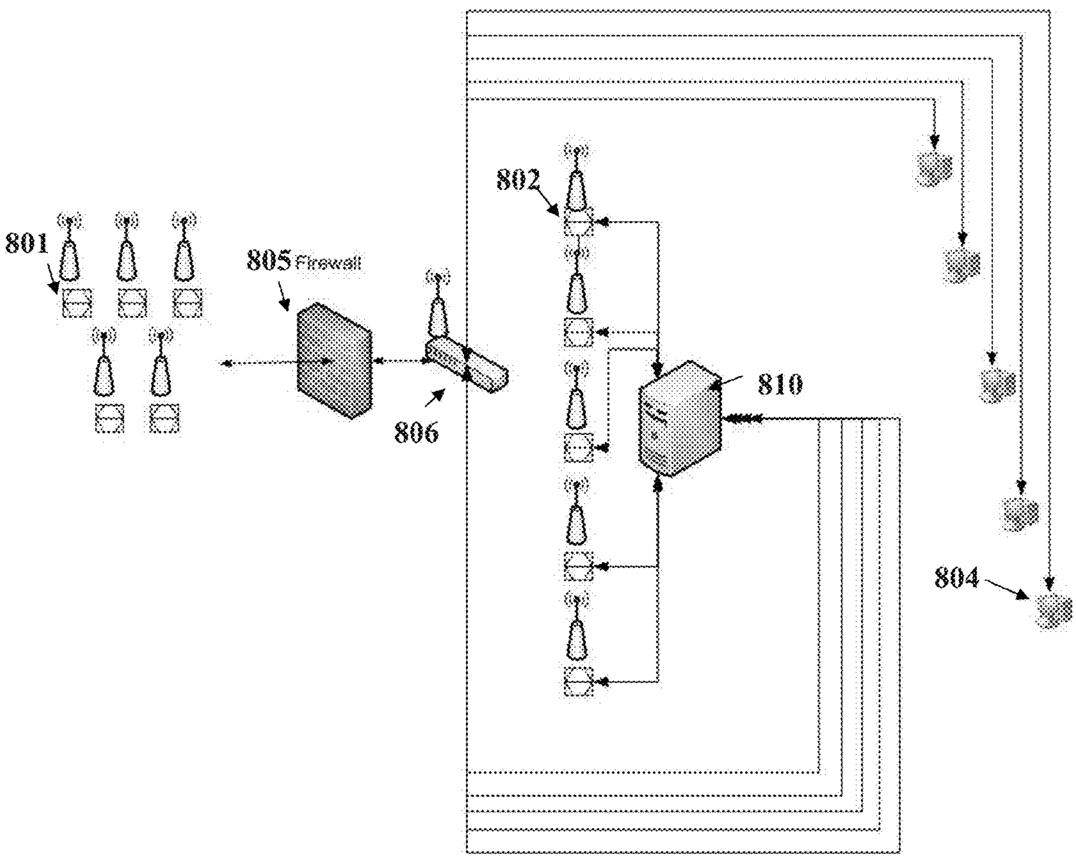

Figure 8

REMOTE VEHICLE PROGRAMMING SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATION

This application is a divisional of application Ser. No. 12/977,830, filed 23 Dec. 2010, now U.S. Pat. No. 8,688, 313.

TECHNICAL FIELD

The present invention relates to vehicle programming systems and more particularly to a system and method for remotely programming a vehicle.

BACKGROUND OF THE INVENTION

On-board diagnostics ("OBD") systems allow a vehicle owner or technician to access vital information about the various modules and sub-systems within the vehicle. For many years, manufacturers have included complex OBD systems in their vehicles. Such OBD systems are typically accessible through a data link connector ("DLC") located under the dash of the vehicle. In a traditional repair setting, a technician utilizes a specialized scan tool that is adapted to interface with a given vehicle's OBD system over the vehicle's DLC. The scan tool is capable of reading data from the vehicle's sub-system for diagnostic purposes while also permitting the reprogramming of the sub-systems as desired. Typically these scan tools are stand-alone handheld computing devices, but there are some personal computer-based scan tools known in the art.

The first OBD systems, now known as OBD-I, were initially implemented to monitor a vehicles emission control system for regulatory purposes. However, OBD-I was largely unsuccessful due to the lack of standardization of the OBD's placement within the vehicle, DLC configuration, and data format.

In response to the problems associated with OBD-I, OBD-II was developed. OBD-II presented a substantial improvement over OBD-I in both capability and standardization. The OBD-II standard specifies the type of diagnostic connector and its pinout, the electrical signaling protocols available, and messaging format. OBD-II also provides a candidate list of vehicle parameters to program, along with how to encode the data for each. OBD-II also introduced a standardized DLC—the female 16-pin (2×8) J1962 connector, as show in FIG. **1**. Unlike the OBD-I connector, which was sometimes found under the hood of the vehicle, the OBD-II connector is required to be within 2 feet (0.61 m) of the steering wheel, and therefore is usually located under the dashboard. OBD-II also provided for a pin in the connector that provides power to the scan tool from the vehicle's battery, eliminating the need to connect a scan tool to a separate power source. Finally, the OBD-II standard provided an extensive list of standardized diagnostic trouble codes.

SAE J1962 defines the location of the OBD connector (i.e. within 2 feet of the steering wheel) and the pinout configuration thereof, as follows:

1. Manufacturer discretion.
2. Bus positive Line (for SAE-J1850 PWM and SAE-1850 VPW protocols)
3. Ford DCL(+) Argentina, Brazil (pre OBD-II) 1997-2000, USA, Europe, etc. Chrysler CCD Bus(+)
4. Chassis ground

5. Signal ground
6. CAN high (for ISO 15765-4 and SAE-J2284 protocols)
7. K. line (for ISO 9141-2 and ISO 14230-4)
8. -
9. -
10. Bus negative Line (for SAE-J1850 PWM protocol)
11. Ford DCL(−) Argentina. Brazil (pre OBD-II) 1997-2000, Usa, Europe, etc. Chrysler CCD Bus(−)
12. -
13. -
14. CAN low (for ISO 15765-4 and SAE-J2284 protocols)
15. L line (for ISO 9141-2 and ISO 14230-4 protocols)
16. Battery voltage

Although OBD-II provided some advantageous standardization across many vehicle manufacturers, the manufacturers still chose to employ different communication. protocols, i.e. signal formats, for their particular OBD systems. Such protocols include, for example SAE J1850 PWM, SAE VPM, ISO 9141-2, ISO 14230, and ISO 15765. Each of these protocols varies in pinout configuration and signal characteristics.

For example, SAE J1850 PWM (pulse-width modulation—41.6 kB/sec, standard of the Ford Motor Company) has the following characteristics

pin 2: Bus+
pin 10: Bus−
High voltage is +5 V
Message length is restricted to 12 bytes, including CRC
Employs a multi-master arbitration scheme called 'Carrier Sense Multiple Access with Non-Destructive Arbitrational' (CSMA/NDA)

SAE J1850 VPW (variable pulse width—10.4/41.6 kB/sec standard of General Motors) has the following characteristics:

pin 2: Bus+
Bus idles low
High voltage is +7 V
Decision point is +3.5 V
Message length is restricted to 12 bytes, including CRC
Employs CSMA/NDA

The ISO 9141-2 protocol has an asynchronous serial data rate of 10.4 kBaud and is primarily used in Chrysler, European and Asian vehicles. It has the following characteristics:

pin 7: K-line
pin 15: L-line (optional)
UART signaling (though not RS-232 voltage levels)
K-line idles high
High voltage is Vbatt
Message length is restricted to 12 bytes, including CRC

ISO 14230 KWP2000 (Keyword Protocol 2000) has the following characteristics:

pin 7: K-line
pin 15: L-line (optional)
Physical layer identical to ISO 9141-2
Data rate 1.2 to 10.4 kBaud
Message may contain up to 255 bytes in the data field

The ISO 15765 CAN (controller area network vehicle bus) (250 kBit/s or 500 kBit/s) protocol is a popular standard outside of the US automotive industry and is making significant gains into the OBD-II market share. As of 2008, all vehicles sold in the US are required to implement CAN, thus eliminating the ambiguity of the existing five signaling protocols.

pin 6: CAN High
pin 14: CAN Low

Accordingly, because of the varying communication protocols, it is often necessary for a technician to purchase several different scan tools, each compatible with a particular OBD-II signal protocol. For example, a technician may need one scan tool for cars manufactured by the Ford Motor Company, and another scan tool for cars manufactured by General Motors. Thus, if a technician wishes to service a wide variety of vehicle makes and models, he often will have to make a substantial investment in scan tools. Moreover, because most scan tools are handheld devices that connect directly to a vehicle's DLC, the technician must carry out service directly next to, or inside of, the vehicle, itself, which may be cumbersome or unsafe in a typical "garage" environment.

Moreover, there are typically two types of scan tools known in the art. A typical "aftermarket" scan tool has limited capability, only being capable of interfacing with certain modules and sub-systems, such as the engine control module and transmission control module, for purposes of maintaining proper fuel efficiency and emissions. Often, these aftermarket scan tools are limited to interfacing with those systems as dictated by SAE J2534. These aftermarket scan tools generally do not have the ability to read, analyze, manipulate, and reprogram the numerous other vehicle modules and sub-systems discussed below. A manufacturer-specific scan tool, on the other hand, is a scan tool designed to interface with all of the modules and sub-systems found within a vehicle and provides the ability to read, analyze, manipulate, program and reprogram such modules and subsystems. Of course, the manufacturer-specific scan tools are much more expensive to own and maintain than the limited aftermarket scan tools. For one, the scan tool hardware itself is more expensive, but more importantly, the manufacturer-specific scan tools require daily, weekly, or monthly software updates in order to take advantage of the latest programming software. Accordingly, if a technician wishes to offer a full range of services for a particular vehicle manufacturer, he will have to purchase the expensive manufacturer-specific scan tool and a subscription so that he can obtain the latest software updates.

Various systems and methods for interfacing with a vehicle's OBD system are known in the art:

For example, U.S. Pat. No. 6,956,501 to Kitson describes an improved vehicle monitoring system for measuring the performance of the vehicle, including a wireless communication link for transmitting vehicle information to a terminal proximate to the vehicle, i.e. at a fuel station. The local terminal processes the information and communicates it to the operator of the vehicle through a display or other means. The system described in Kitson, however, is undesirable for at least two reasons. First, the system is only adapted for diagnostics and monitoring, i.e. "reading" data, and is not sufficient for vehicle programming, i.e. altering vehicle sub-systems. Second, Kitson only allows the transmission of vehicle data to a location proximate, i.e. next to, the vehicle. Kitson fails to provide for a system or method that enables a technician to program a vehicle's systems from a location substantially remote from the location of the vehicle.

U.S. Pat. No. 7,519,458 to Buckley describes a system, apparatus and method for obtaining and analyzing select vehicle data obtained from a vehicle. The system includes an interface communicatively coupled to the vehicle that obtains vehicle data associated with the operation of the vehicle. The system then communicates with a remote node via a network in order to obtain the necessary information to properly analyze the vehicle data. Once it has obtained the necessary information, the vehicle data is analyzed for

diagnostic and monitoring purposes. Buckley, however, fails to provide for a system that is capable of carrying out bidirectional vehicle programming tasks from a remote location.

U.S. Patent Application Pub. No. 2005/0251304 to Cancellara, et. al. describes a system for performing both local and remote vehicle diagnostics, comprising a vehicle communications unit that acts as an intelligent interface to a vehicle to which it is connected and that is capable of performing autonomous vehicle diagnostics and communication functions. The system in Cancellara is designed only to provide for remote diagnostics, and does not describe a system and method for programming a vehicle. Moreover, Cancellara contemplates real-time diagnostics, i.e. "reading," of a vehicle in operation, and not programming or manipulation of vehicle sub-systems.

U.S. Pat. No. 7,532,962 to Lowrey et. al. describes a system for monitoring a vehicle's operational characteristics having a wireless appliance in contact with an in-vehicle computer having a data-collection component that supports communications software that collects diagnostic data from the computer, and a data-transmission component in communication with the data-collection component, configured to transmit an outgoing data packet comprising the diagnostic data over a network and receive over the same network an incoming data packet that modifies the communication software. Lowrey, like much of the prior art, provides for a system for carrying out diagnostics of a vehicle's operational characteristics, but does not provide system or method for remote programming of a vehicle.

U.S. Patent Application Pub. No. 2009/0265055 to Gillies describes a hand-held interface device configured to wirelessly communicate with a wireless OBD device in a vehicle to be repaired. A network access point and other wireless devices may be used to access vehicle information, repair instruction, diagnostic information research information, remote expert guidance, remote databases and applications, and other repair and diagnosis information from the interface device. The system in Gillies essentially captures vehicle information, relays the information to a server, wherein the server provides assistance information to a technician based on the vehicle information. The system, however, is not capable of providing remote programming, to the vehicle from the server.

U.S. Pat. No. 7,584,030 to Graham releasable connectors with a wireless connection between automotive test equipment and a vehicle's OBD computer wherein the data link cable is replaced, using two connectors which have been pre-programmed to communicate with each other. The device in Graham concerns local wireless communication between the vehicle's OBD and a scan tool through a wireless link established by the device. Graham does not contemplate remote transmission of programming data over a data network, nor does it contemplate remote programming of the vehicle over that network.

Accordingly, there is a need in the art for a system and method that allows a technician to service and program a vehicle, through its ODB interface, from a remote location. There is a further need in the art for a system and method for programming a vehicle that does not require a shop or garage to purchase numerous expensive scan tools for each specific vehicle make and/or model. There is a further need in the art for a system and method of programming a vehicle from a remote call center that has the capabilities to program a wide variety of vehicles implementing a wide variety of OBD communication protocols. There is a further need in the art for a system and method of programming a vehicle

from a remote call center that has the capabilities of always having the most recent scan tool software for a wide variety of vehicle manufactures and model years. These and other objectives of the various embodiments of the present invention will become readily apparent in the following specification and appended claims.

SUMMARY OF THE INVENTION

Disclosed herein are various embodiments of a system and method for remotely programming a vehicle, In some embodiments, the system comprises a vehicle connector with a plurality of pins in communication with one or more vehicle subsystems or modules, a vehicle communication device connected to the vehicle connector, a bi-directional communication link between the vehicle communication device and a remote communication device, and a computer system connected to the remote communication device. The vehicle communication device is configured to receive signals from the pins, convert the signals to a network compatible data packet which can then be transmitted to the remote communication device, which re-converts the signals to the pin signals, which can be read by a computing system, such as a vehicle scan tool. Programming instructions can be sent from the scan tool to the vehicle, over the bidirectional communication link between the remote communication device, and the vehicle communication device. In some embodiments, programming instructions are selected from the group of instructions consisting of reprogramming, program updating, calibration, linking, marriage, serial coding, security coding, and combinations thereof.

In some embodiments, the scan tool comprises a handheld computer scan tool known in the art. In other embodiments, the scan tool comprises a computer workstation executing scan tool emulation software.

In some embodiments, the bi-directional communication link is carried over an electronic communications network, such as the Internet, and allows web-based communication between the vehicle communication device and the remote communication device.

In some embodiments, the vehicle communication device and the remote communication device each have a socket, a communications processor and a modem coupled to said communications processor. The socket of the vehicle communication device is adapted to engage a vehicle connector having a plurality of pins in communication with a one or more vehicle sub-systems, and the socket of said remote communication device adapted to engage a vehicle scan tool or like computer workstation. Again, the vehicle communication device and the remote communication device enabled to communicate over the bi-directional communication link, established between the modems of the respective devices. In some embodiments, the modems utilize a wired connection to the bi-directional communication link, such as Ethernet, universal serial bus, or the like. In other embodiments, the modems utilize a wireless connection to the bi-directional communication link, such as Wifi, Bluetooth, or a cellular data communications network.

In some embodiments, the present invention concerns a method of remotely programming one or more sub-systems of a vehicle, including the steps of: establishing a bi-directional communication link between a vehicle communication device and a remote communication device, where the vehicle communication device is in communication with one or more of the vehicle sub-systems and the remote communication device is in communication with a computer system or scan tool; requesting, from the vehicle communication device over the bi-directional communication link, one or more outgoing pin signals from one or more of the vehicle sub-systems; receiving, on the remote communication device over the bi-directional communication link, a network-compatible vehicle packet corresponding to the outgoing pin signals; converting, on the remote communication device, the vehicle packet to one or more of the outgoing pin signals; and transmitting the one or more outgoing pin signals to the computer system.

In some embodiments, the remote vehicle programming method also includes the steps of generating programming instructions on the computer system; transmitting those programming instructions from the computer system to the remote communication device; converting, on the remote communication device, the programming instructions to a network-compatible programming packet; and transmitting the programming packet to the vehicle communication device over the bi-directional communication link.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a diagram of one embodiment of a vehicle OBD connector.

FIG. **2** is a schematic of one embodiment of the communication interface devices of the present invention.

FIGS. **3-8** are several embodiments of the system of the present invention, depicting the various component parts thereof.

DETAILED DESCRIPTION OF THE INVENTION

The present invention concerns several non-limiting embodiments of a system and method for remotely programming a vehicle by way of the vehicle's OBD connector. A 16-pin OBD vehicle connector **1** such as that shown in FIG. **1** is typically located under the dashboard in most modern vehicles, and accessible by a vehicle operator or technician. In some embodiments of the present invention, vehicle connector **1** is interfaced with the various electronic control units or "modules" located in the vehicle. Such units and modules may include, but are not limited to: Air bag control module; Alarm Control Module; Antenna Control Module; Automatic Control Module; Body Control Module; Cabin Heater Control Module; Central Control Module; Charging Control Module; Communication Control Module; Door Control Module; Electronic Brake Control Module; HVAC Control Module; Electronic Throttle Control Module; Engine Control Module; Headlamp Control Module; Instrument Control Module; Navigation Control Module; Park Assist Control Module; Power Mirror Control Module; Power seat control Module; Radiator Fan Control Module; Seat Heater Control Module; Steering Column Control Module; Steering Control Module; Steering Mounted Control Module; Sunroof Control Module; Transmission Control Module; Transfer Case Control Module; General Electronic Control Module; Moonroof Control Module; Suspension Control Module; Tire Pressure Control Module; Traction Control Module; Trailer Light Control Module. For purposes of this disclosure, these units and modules will be referred to collectively as vehicle "sub-systems."

In some embodiments, vehicle connector **101**, as shown in FIG. **1**, has two rows each of eight pins **102**. Pins **102** are in communication with the various vehicle sub-systems such as those listed above. Accordingly, in any given vehicle, each of the sixteen pins **102** are enabled to output a vehicle signal corresponding to a particular sub-system or other function,

it is understood that it is not necessary that a signal is present on all sixteen pins **102** simultaneously; rather, the signal configuration of pins **102** can vary on a pin-by-pin basis according to a desired communication protocol, i.e. signal format. For exemplary purposes only, such communication protocols may include the above described SAE J1850 PWM, SAE VPM, ISO 9141-2, ISO 14230, and ISO 15765 protocols.

It is understood that the vehicle signals present on each of the pins **102** may be analog, or digital, and such format need not be the same across all pins **102**. It is further understood that in some embodiments, vehicle connector **101** may be configured as a "female" connector and in others it may be configured as a "male" connector.

As noted above, it is usual for a scan tool or other computing device to be connected to vehicle connector **101** by a data cable, for the scan tool to receive vehicle data corresponding to the various vehicle sub-systems. To that end, the scan tool or computing device usually must be located proximate to the vehicle for data analysis and programming to be carried out. However, the present invention contemplates a bi-directional communication system that is adapted to transmit the vehicle signals present on pins **102** across a computer network for remote data analysis and manipulation and to permit remote programming of the subject vehicle's sub-systems. The bi-directional communication link between the vehicle and the remote location allows a technician at the remote location to program a vehicle via a scan tool or computing system, as if he were standing proximate to the vehicle.

As shown in FIG. **2**, one aspect of the present invention contemplates a communication system and associated methods comprising two communications devices, hereafter referred to as "CIDs." As noted above, the purpose of the CIDs is to create a bi-directional communication link between a subject vehicle's vehicle connector **101** at one location and a scan tool or computer at a second, remote location such that a technician can remotely program the subject vehicle. Accordingly, shown schematically are embodiments of vehicle CID **201** and remote CID **202**. in some embodiments, Vehicle CID **201** has a socket **211**, communications processor **241**, and modem **261**. Similarly, remote CID **202** has a socket **212**, communications processor **222**, and modem **262**.

Vehicle CID **201** is engaged with vehicle connector **101** via socket **211**. In some embodiments, socket **211** is configured to engage pins **102** of vehicle connector **101**, such that the vehicle signals present on pins **102** can be received by CID **201** and processed by communications processor **241**. To that end, communications processor **241** contains operational logic that enables outgoing pin signals **221** to be converted to a network-compatible packet, vehicle packet **251**, which can be transmitted over a computer network to remote CID **202**, by modem **261**.

Remote CID **202** is in communication with a scan tool or computing system whereby socket **212** is engaged with scan tool connector **103**, which has the same pin configuration as the vehicle connector **101** described above. Accordingly, remote CID **202** is enabled to request and receive vehicle packet **251** (from modem **261** of vehicle CID **201**) via modem **262**, to which communications processor **222** processes the packet, re-converts it to pin signals, which can then be communicated to a scan tool or computer system (over scan tool connector **103**) for analysis and programming. In that sense, the vehicle packet **251** provides "read" data for remote CID **202**, which can be used to determine the present state of a given vehicle sub-system, as well as

determine whether there are errors, anomalies, or other problems with that sub-system.

Accordingly, a technician can utilize the scan tool or computer system to send programming instructions to the vehicle over the bi-directional communications link. For example, programming instructions are sent from the scan tool or computer system over scan tool connector **103** to remote CID **202** via socket **212**. As the programming instructions are initially signals that are pin-compatible, the communications processor **222** of remote CID **202** converts the signals much in the same manner as described above with respect to vehicle CID **201**, and then relays a network-compatible programming packet **232** over the bi-directional communications link (i.e. modem **262** to modem **261**) to vehicle CID **201**. Vehicle CID **201** receives the programming packet **232** and re-converts it to vehicle-compatible incoming pin signals **232** which are passed to the vehicle through the socket **211**-vehicle connector **101** engagement.

As shown and described in FIG. **2**, communication processors **241** and **222** contain software logic to request and read vehicle-compatible pin signals, determine the communication protocol, i.e. signal format, of those pin signals and convert the pin signals to a network-compatible data packet. Accordingly, in some embodiments, the vehicle packet **251** and programming packet **232** may contain data to identify the communication protocol of the incoming and outgoing data. In some embodiments, this identifying information is necessary in order for the scan tool or computing system to determine the proper programming software, dependent on, for example, vehicle make and model. In other words, to the extent that each vehicle manufacturer has a unique communication protocol, i.e. signal format, the scan tool or computing system is capable of recognizing that protocol in order to properly program the vehicle. The various communications protocols may include, but are not limited to, those discussed in the Background section of this disclosure above.

Based on the foregoing, it is understood that vehicle CID **201** and remote CID **202** enable a bi-directional exchange of information. Vehicle data, i.e. vehicle packet **251**, is sent to the remote location which can then be read, analyzed, and processed by a technician who can send new vehicle data, i.e. programming packet **232**, back to the subject vehicle. It is understood that, once the bi-directional communication link is established, data transfer can be initiated from either the vehicle, or the remote location, depending on the situation and desired programming tasks. In some embodiments, the remote CID **202** requests output pin signal information from vehicle CID **201**, which is then transmitted to remote CID **202** as vehicle packet **251**.

In some embodiments, modems **261** and **262** communicate with a computer network over a wired connection such as a standard telephone connection (RJ-11), category-5 Ethernet connection (RJ-45), universal serial bus (USB) connection, firewire (IEEE1394), or other serial or parallel data transmission connections known in the art. In some embodiments modems **261** and **262** communicate with an electronic communications network over a wireless connection such as WiFi, Bluetooth, Near-Field Communication (NFC), or a cellular data communications network protocol such as GSM, UMTS, or CDMA, EDGE, 3G, 4G, LTE, HSPA, HSDPA, EV-DO, or the like. The modems do not have to be utilizing the same connection standard, as long as each can access the electronic communications network (for example, the Internet) to establish the bi-directional communication link.

It is understood that each particular vehicle CID **201** and remote CID **202** may optionally have a unique identifier, such as a unique static internet protocol ("IP"). address or other identification code, embedded within its logic. The unique identifier can be included in, or in addition to, the vehicle packet sent from vehicle CID **201** to remote CID **202**. In some embodiments, the unique identifier assists the remote location in identifying the source and ownership information for a given vehicle CID and can also be used to verify that the vehicle. CID is being operated by the correct entity, i.e. the individual technician or shop that the vehicle CID has been assigned to.

In some embodiments, the vehicle CID **201** is enabled such that its internal software and logic can be configured before use to initiate and maintain a proper bi-direction communication link with the remote CID **202**. For example, upon receiving a vehicle CID **201**, the technician or shop may temporary connect it to a local computer or workstation (by USB, Bluetooth, or other wired or wireless connection protocols discussed herein) and execute appropriate software to configure the vehicle CID **201** to connect to the shop's Internet connection and to communicate with the remote CID **202** at the remote location. Accordingly, the vehicle CID **201** (as well as the remote CID **202**) may have internal memory that is capable of storing configuration data such that it is capable of re-connected to the Internet during subsequent use, without the need for further configuration. It is understood, however, that configuring the vehicle CID **201** does not have to be carried out by a local computer or workstation, rather configuration can be done through an interface on the device itself o it may be pre-configured when the shop obtains it.

FIGS. **3**-**8** depict various embodiments of the remote vehicle programming system and method of the present invention. Beginning with FIG. **3**, shown is vehicle CID **301**, remote CID **302**, scan tool **303**, and workstation **304**, it being understood that vehicle CID **301** is proximal to the subject vehicle and the remaining components, namely remote CID **302**, scan tool **303**, and workstation **304**, are at a location remote from the location of the vehicle.

In accordance with the above, vehicle CID **301** is engaged with the pins **102** of the vehicle connector **101** (not shown) of a subject vehicle (not shown). A bi-directional communication link is established between vehicle CID **301** and remote CID **302** over an electronic communications network, such as the Internet. It is understood that the communication between the two CIDs **301** and **302** occurs via the modems (not shown) of each and in this case, over a wired connection.

Vehicle CID **301** is enabled to receive the vehicle signals present on pins **102**, convert the vehicle signals to a network-compatible data packet and relay the data packet, i.e. the vehicle packet, to remote CID **302** over the bi-directional communication link. Remote CID **302** is configured to request and receive the vehicle packet and convert it back to vehicle-compatible signals. The vehicle signals can then be processed and analyzed by scan tool **303**, which is in communication with remote CID **302** through an OBD connection (like, for example, scan tool connection **103** described above), as if the scan tool **303** directly connected to vehicle CID **301**.

Accordingly, scan tool **303** is a computing system including specialized software that is adapted to process the particular communication protocols of the vehicle signals outputted from a given vehicle. The scan tool can also generate new programming information, independent or dependent of the vehicle signals, and output the information back to the CID system as vehicle-compatible programming signals.

Because the communication link is bi-directional, vehicle-compatible programming signals can be sent from scan tool **303** and/or workstation **304** to remote CID **302**. Remote CID **302** then converts the programming signals to a network-compatible data packet, i.e. programming packet, which can be relayed back to vehicle CID **301**. Vehicle CID **301** then re-converts the programming packet to vehicle compatible programming signals (pin compatible) which are then transmitted to the particular vehicle sub-systems over pins **102** of vehicle connector lift. Accordingly, vehicle packets and programming packets can be exchanged between the vehicle and the remote location, in either direction, to enable remote analysis and programming of the vehicle.

It is understood that because each vehicle make and model may have different ODB communication protocols, i.e. signal formats, it may be desirable to have available a lumber of different scan tools **303** to assure compatibility. Accordingly, as discussed above, the CIDs **301** and **302** may be configured to include communication protocol, i.e. signal format, data across the bi-direction communications link in order for the scan tool **303** to properly identify, read, analyze, and manipulate vehicle packets. Optionally, scan tool **303** can be in communication with workstation **304** (via network switch **306**) allowing remote manipulation of scan tool **303**. In this arrangement, a plurality of scan tools **303** and their corresponding remote CIDs **302** can be located in a discrete area of the remote location wherein the workstations **304** are elsewhere at the remote location, such as a call-center or cluster of desks or cubicles.

FIG. **3** depicts a plurality of vehicle CIDs **301**, remote CIDs **302**, scan tools **303**, and workstations **304**. Accordingly, the present invention contemplates that more than one vehicle may be serviced and programmed at a given time, and thus it is desirable to have multiple systems operating simultaneously. Accordingly, network switch **306** may be introduced at the remote location to permit a plurality of remote CIDs **302** to receive data over a single network connection (i.e. Internet connection). In some embodiments, each CID is configured to identify and transmit information concerning the communication protocol, i.e. signal format, in order for the scan tool to properly identify the vehicle data. Further, the plurality of workstations **304** are connected to the system and placed in communication with scan tools **303** via network switch **306**. Optionally shown is firewall **305** which may be placed before network switch **306** to secure the system in accordance with known network security and encryption protocols.

Turning to FIG. **4**, shown is vehicle CID **401**, remote CID **402**, workstation **404**, firewall **405**, and network switch **406**. In this embodiment, the scan tool is omitted in favor of emulation software running on workstation **404**, which is interfaced to the system via network switch **406**. The emulation software is designed to read and process vehicle signals received from remote CID **402**, and, based on the communication protocol, call up the appropriate make and model scan tool software to permit data analysis and vehicle programming. In accordance with this embodiment, workstation **404** may have an appropriate OBD connector in order to interface with remote CID **402**.

FIG. **5** depicts vehicle CID **501**, remote CID **502**, scan tool **503**, workstation **504**, firewall **505**, network switch **506**, and thin client **507**. In this embodiment, scan tool **503** is coupled to thin client **507** which is in turn coupled to

workstation **504**, all via network switch **506**. Accordingly, data analysis and programming can be conducted from workstation **504**, with instructions relayed to thin client **507** and then to scan tool **503**. In this configuration, thin client **507** has the effect of reducing computing resource requirements on workstation **504**, as well as provides an additional means of data security and encryption. FIG. **6** depicts a similar system configuration as that shown in FIG. **5**, however utilizing wireless communication for vehicle CID **601**, remote CID **602**, and network switch **606**.

Turning to FIG. **7**, shown is vehicle CID **701**, remote CID **702**, workstation **704**, firewall **705**, network switch **706**, and server **710**. In this embodiment, the scan tool is omitted in favor of emulation software running on server **710**, with server **710** configured as a "cloud" for workstations **704**, which components are interconnected via network switch **706**. The emulation software is designed to read and process vehicle signals received from remote CID **702**, and, based on the communication protocol, call up the appropriate make and model scan tool software to permit data analysis and vehicle programming. In accordance with this embodiment, server **710** may have an appropriate OBD connector in order to interface with remote CID **702**. Workstation **704** interfaces with server **710** to retrieve vehicle packets, conduct programming and analysis, and relay programming packets to vehicle CID **701**. FIG. **8** depicts a similar configuration, utilizing wireless communication.

As noted throughout this disclosure, the system and method of the present invention allows for remote programming a plurality of vehicle subs-systems from a remote location. The term "programming" therefore contemplates a variety of actions that can be carried out on the vehicle sub-systems, by way of specifically designed programming packets relayed from the scan tool or computing system to the vehicle over the vehicle CID-remote CID bi-directional communication link. Such actions may include, but are not limited to, reading, reprogramming, program updating, calibration, linking, marriage, serial coding, and security coding.

"Reprogramming" may comprise relaying programming packets enabled to replace, alter, reset, or otherwise change defective or absent programming in a vehicle sub-system with complete and up to date programming information.

"Program update" may comprise relaying programming packets enabled to replace existing, but out-dated programming in a sub-system with the latest original equipment manufacturers' (OEM) programming and configuration. Alternatively, these packets may include custom programming updates. Such programming updates may contemplate, for example, performance upgrades to the engine control module, transmission control module, and related modules in order to increase engine horsepower output or shifting intervals. These program updates are particularly useful for "tuning" high performance vehicles such as racing cars and "hot rods."

"Calibration" may comprise relaying programming packets enabled to tune the output signals from various sensors with the vehicle sub-systems to correctly read input signals coming from other vehicle sub-system. Additionally, "calibration" contemplates the resetting of "set-points" or parameters within the vehicle sub-systems.

"Linking" or "pairing" may comprise relaying programming packets enabled to establish bi-directional communication between two or more vehicle sub-systems. This is a required step when replacing a module or sub-system in a vehicle, so that the other modules or sub-systems will accept and communicate with it.

"Marriage" is similar to linking except that it involves integration at the vehicle level and not just sub-system to sub-system communication. For example, the programming packet may instruct a sub-system to communicate with the vehicle to identify its vehicle identification number VIN to verify that the sub-system belongs in that vehicle. "Serial coding" is another term for linking or marriage.

Finally, "security coding" may comprise relaying programming packets enabled to link or marry a particular security-related sub-system with the vehicle, for example the door control module or security module.

It is understood that, for purposes of carrying out these programming activities or actions, it will often be desired for the remote CID to conduct a "read" of the vehicle to determine the present state of the various vehicle sub-systems, by way of the vehicle CID. Accordingly, in some embodiments, vehicle CID sends vehicle packets to remote CID which are read and analyzed by the scan tool, workstation, or other computing system in order to determine if there are errors or missing elements within the particular sub-system. At that point, a technician can generate, on the scan tool or computing system, specifically designed programming packets designed to carry out the various actions disclosed herein, in order to correct, replace, reset or manipulate the state of the sub-system(s), depending on a desired result.

Moreover, the programming actions disclosed herein are adapted to be performed in either "key-on" or "key-off" operating mode. In "key-on" mode; the system and method herein can be utilized to read, analyze, manipulate, and program certain sub-systems that are active when the vehicle's engine is operating. It may be desirable to carry out data analysis and programming when the engine is operating because certain of the sub-systems output different data as compared to a "key-off" operating mode. On the other hand, "key-off" operating made may cause certain sub-systems to "lock out" and prevent data analysis, and programming, for safety purposes; therefore, "key-off" operating mode may be necessary to program certain of those sub-systems.

As noted throughout this disclosure, the present invention contemplates a variety of useful methods incorporating the various components of the remote vehicle programming system disclosed herein. In a practical setting, remote vehicle programming in accordance with the present invention may occur in several ways. One example concerns an "appointment" model. In this example, the shop or garage at one location schedules an appointment for vehicle programming with a "call center" at the remote location. At the appropriate time, the shop connects its vehicle CID to the subject vehicle's OBD connector and then initiates a connection between the vehicle CID and the Internet. At substantially the same time, the call center initiates a connection between its remote CID and the Internet. The call center then places a telephone call or initiates some other form of direct communication with a technician or other individual at the shop in order to confirm that the vehicle CID has a proper connection to the Internet. Once the connection has been confirmed, the call center establishes the bi-directional communication link between the remote CID and the vehicle CID, identifying the vehicle CID using the previously mentioned unique identifier information.

At that point, data can be exchanged between the vehicle CID and remote CID. In some embodiments, once the bi-directional communication link has been established, the call center, using workstation, scan device, server, or combinations thereof, begins relaying programming packets from the remote location to the vehicle. In other embodi-

ments, the call center begins first by receiving vehicle data from the vehicle, and then analyzes the data to carrying out appropriate programming. However, these examples are to be construed as non-limiting as the bi-directional communication link is dynamic and, therefore, any desired sequence of data communication and programming is possible.

In other embodiments, programming may be accomplished on an "on-demand" basis rather than "appointment" basis. Accordingly, the shop at one location connects its vehicle CID to a subject vehicle's OBD connector and then initiates a connection between the vehicle CID and the Internet. Then, the shop sends a "job request" to the call center at the remote location by telephone, by computer, or even by the vehicle CID itself. The call center receives the job request after which it initiates the bi-directional communication link between the appropriate remote CID and the vehicle CID. At that point, data analysis, manipulation, and sub-system programming can begin.

As mentioned previously, in some embodiments, the call center may employ numerous remote CID-scan tool/workstation combinations in order to provide programming capabilities for a wide variety of OBD communication protocols, i.e. signal formats. Accordingly, the call center may have an array of remote CIDs and scan tools in place, to provide optimal compatibility and flexibility. When the bi-directional communication link is first established, the remote CID will request and receive communication protocol information from the vehicle packet sent from the vehicle CID. The call center, therefore, is configured to read the communication protocol information in order to configure the appropriate scan tool/workstation/emulation sever to begin programming.

While many of the embodiments of the present invention disclosed herein concern passenger automobiles, the term "vehicle" should not be construed as limiting. Accordingly, the system and method herein has many applications, including but not limited to, marine, aircraft, heavy equipment, commercial vehicles, stationary equipment, and industrial equipment, provided such machines are controlled by various electronic control modules and sub-systems and are adapted to be programmed by a scan tool or computing system.

It is further understood that the scan tools, servers, and workstations implemented in the present invention as discussed above may comprise a variety of computing systems including, but not limited to, a computer server, a personal computer, a laptop computer, a netbook computer, a tablet computer, a mobile telephone such as a smartphone, and the like. The following description of the typical computing system is included only for illustrative purposes and should not be considered a limitation of the invention. Although this description may refer to terms commonly used in describing particular types computing system, the described concepts apply equally to other computing system, including systems having, architectures that are dissimilar to that described.

The computing systems such as scan tools (being a "handheld" computing system), servers, and workstations described above may include a central processing unit (CPU) having a conventional microprocessor, random access memory (RAM) for temporary storage of information, and read only memory (ROM) for permanent storage of "read only" information. A memory controller is provided for controlling system RAM. A bus controller is provided for controlling a data bus, and an interrupt controller is provided for receiving and processing various interrupt signals from the other system components. Data storage may be provided

by known non-volatile, removable media storage drives, such as a diskette drives, DVD drives, CD-ROM drives, ZIP® drives, flash drives, magneto-optical ("MO") drives, and the like, or by non-removable storage systems like hard drives. Data and software may be exchanged with the computing systems via removable media, such as floppy diskettes, CD-ROMs, DVDs, ZIP® disks, MO disks, flash drives and the like. The removable media is insertable into a compatible removable media storage drive, which, in turn, utilizes a controller to interface with the data bus. The non-removable storage system is part of a fixed disk drive, which utilizes a hard drive controller to interface with the data bus. User input to the computer may be provided by a number of devices. Examples include a keypad, a keyboard, a mouse, and a trackball, which may be connected to the data bus by an input controller direct memory access (DMA) controller is provided for performing direct memory access to system RAM. A visual display may be generated by the graphics subsystem of the computing system that controls the display device attached to the computing system. The display device can be a conventional cathode ray tube ("CRT"), liquid crystal display ("LCD"), light-emitting diode ("LED"), or plasma monitor having individually addressable picture elements ("pixels".) The pixels are arranged in a two-dimensional X-Y grid arid are selectively illuminated, as directed by the graphics subsystem, for assembling an image, or a series of images (or frames) to create moving pictures.

A network interface adapter also may be included that enables the various computing systems to connect to the described network via a network bus. The network, which may be a local area network (LAN), a wide area network (WAN), an electronics communication network, i.e. the Internet, or the like, may utilize general purpose communication protocols that interconnect a plurality of network devices. The computing system is controlled and coordinated by operating system ("OS") software, such as for exemplary purposes only, Windows®, Mac OSX, Apple iOS, Linux, Unix, Android OS, PalmOS, Windows Mobile OS, and the like. Among other functions, the OS controls allocation of system resources and performs tasks such as process scheduling, memory management, networking, and I/O services.

In the foregoing description, the present invention has been described with reference to specific exemplary embodiments thereof. It will be apparent to those skilled in the art that a person understanding this invention may conceive of changes or other embodiments or variations, which utilize the principles of this invention without departing from the broader spirit and scope of the invention. The specification and drawings are, therefore, to be regarded in an illustrative rather than a restrictive sense. Accordingly, it is not intended that the invention be limited except as may be necessary in view of the appended claims.

We claim:

1. A system for remotely programming a subsystem of a subject vehicle, comprising:
- a first communication device located proximate to a subject vehicle comprising:
  - a first interface that interfaces with a vehicle computer system for the subject vehicle and providing bi-directional communication with the vehicle computer system using a standard OBD communications protocol;
  - a second interface that interfaces with a communication network; and

a first communication processor that controls communications over the first and second interfaces; and

a second communication device located remotely from the subject vehicle comprising;

a third interface that interfaces with the communication network, the communication network providing a bi-directional communication link between the first communication device and the second communication device;

a fourth interface that interfaces with a vehicle scan tool located proximate to the second communication device; and

a second communication processor that controls communications over the third and fourth interfaces, wherein the second communication processor is enabled to:

Request, from the vehicle computer system over the bi-directional communication link, one or more outdoing pin signals the vehicle sub-system;

Receive, over the bi-directional communication link, a network-compatible vehicle packet corresponding to the outgoing pin signal;

Convert the vehicle packet to said one or more outgoing pin signals; and

Transmit the one or more outgoing pin signals to the vehicle scan tool;

wherein the first communication device and the second communication device provide communication between the vehicle scan tool and the vehicle computer system to enable the vehicle scan tool to scan and program a vehicle sub-system of the subject vehicle as if the vehicle scan tool were located proximate to the subject vehicle.

2. The system of claim **1**, wherein the second communication is further enabled to:

receive programming instructions from the vehicle scan tool;

convert the programming instructions to a network-compatible programming packet; and

transmit the programming packet to the first communication device over the bi-directional communication link.

3. The system of claim **1**, wherein the bi-directional communication link comprises the Internet.

4. The system of claim **1**, wherein the bi-directional communication link comprises a cellular communication network.

5. The system of claim **1**, wherein the bi-directional communication link comprises a satellite communication network.

6. The system of claim **1**, wherein the a vehicle computer system interfaces with a plurality of vehicle sub-systems of the subject vehicle.

7. The system of claim **1**, wherein the communication between the first communication device and the second communication device is active and continuous.

8. The system of claim **1**, wherein the communication between the first communication device and the second communication device is full duplex.

9. The system of claim **1**, wherein the first interface comprises a first socket adapted to engage a first connector of the vehicle computer system, the first connector comprising a first plurality of pins in communication with the sub-system.

10. The system of claim **1**, wherein the fourth interface comprises a second socket adapted to engage a second connector of the vehicle scan tool, the second connector comprising a second plurality of pins.

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